Elliptic flow in Au+Au collisions at $\sqrt{s_{NN}} = 130$ GeV

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Elliptic flow from nuclear collisions is a hadronic observable sensitive to the early stages of system evolution. We report first results on elliptic flow of charged particles at midrapidity in Au+Au collisions at $\sqrt{s_{NN}} = 130$ GeV using the STAR TPC at RHIC. The elliptic flow signal, v_2, averaged over transverse momentum, reaches values of about 6% for relatively peripheral collisions and decreases for the more central collisions. This can be interpreted as the observation of a higher degree of thermalization than at lower collision energies.

Fig. 1 shows v_2 as a function of centrality of the collision. This figure was made with the subevents chosen with different pseudorapdities, but the same results within errors were obtained with other correlation methods. Restricting the primary vertex z position to reduce TPC acceptance edge effects also made no difference. From the results of the study of non-flow contributions by different subevent selections and the maximum magnitudes of the first and higher-order harmonics, we estimate an averrage systematic error for v_2 of about 0.007, with somewhat smaller uncertainty for the mid-centralities where the resolution of the event plane is high. The systematic errors are not included in the figures.

In the hydrodynamic limit, elliptic flow is approximately proportional to the initial space anisotropy, ϵ. The transformation to the multiplicity axis in Fig. 1 was done using a Hijing simulation assuming 10% vertex-finding inefficiency for low multiplicity events. In comparing the flow results to ϵ, no unusual structure is evident which could be attributed to the crossing of a phase transition while varying centrality. The ϵ values in Fig. 1 are scaled to show the range of hydrodynamic predictions for v_2/ϵ from 0.19 to 0.25. The data values for the lower multiplicities

could indicate incomplete thermalization during the early time when elliptic flow is generated. For the more central collisions, comparison of the data with hydrodynamic calculations suggest that early-time thermalization may be complete.
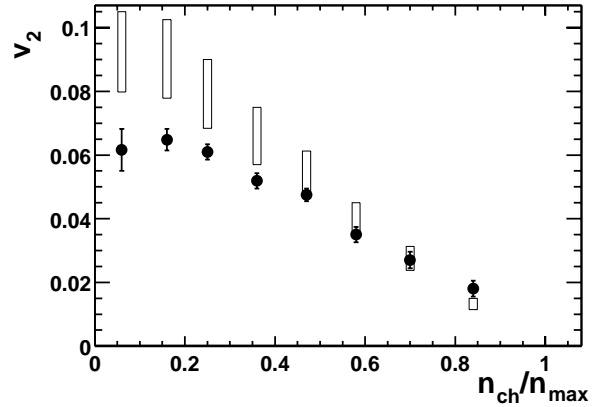

Figure 1: Elliptic flow (solid points) as a function of centrality defined as n_{ch}/n_{max}. The open rectangles show a range of values expected for v_2 in the hydrodynamic limit, scaled from ϵ, the initial space eccentricity of the overlap region. The lower edges correspond to ϵ multiplied by 0.19 and the upper edges to ϵ multiplied by 0.25.

References

[1] Condensed from STAR Collaboration, K.H. Ackermann *et. al*, Phys. Rev. Letters **86**, 402 (2001).